INTERNATIONAL FOOD INFORMATION SERVICE

ifis

FAB 17

MICROBIAL TOXINS IN FOODS

SELECTED FROM VOLUME 13
FOOD SCIENCE AND TECHNOLOGY ABSTRACTS

under the direction of:-

Commonwealth Agricultural Bureaux, Farnham Royal, Slough; Gesellschaft fur Information und Dokumentation, Frankfurt am Main; Institute of Food Technologists, Chicago; Centrum voor Landbouwpublikaties en Landbouwdocumentatie (Pudoc), Wageningen.

INTRODUCTION

Food Annotated Bibliographies (FABs) are collections of abstracts on specific topics in food science and technology. The topics are chosen by the staff of the International Food Information Service as being of particular interest or importance. The topics normally interest individual workers, who may not require the full information provided in Food Science and Technology Abstracts, from which the abstracts for FABs are taken. The size and the cost of the FABs are controlled as much as possible with the interests of individual workers in mind.

Titles of the FABs now available are given on the back cover of this booklet. For up-to-date lists of FABs or suggestions for new topics please write to the address on the back cover. New subjects are searched for at least the five most recent volumes of Food Science and Technology Abstracts. Thereafter each FAB is updated monthly. Copies of each months abstracts on any topic may be obtained as indicated on the back cover of this publication. At the end of each volume of up-dating, the abstracts are merged and made available as a separate supplement to the original FAB.

Some of the larger FABs have been divided into sections to facilitate use. FAB 47 also has a subject and author index provided.

Copies of all original articles referred to in the abstracts may be bought (or occasionally borrowed) from the International Food Information Service. A form for ordering these is provided at the end of this FAB.

Coverage of the subject has been restricted to that of Food Science and Technolggy Abstracts, which covers over 1200 of the important food journals, patents from 20 countries and books published world-wide. Every effort is made to include all significant references, but editorial discretion is used on the many articles of borderline interest. If the reader particularly needs an exhaustive search of the subject, we will be pleased to provide any other references that we have available. We would, in any case, encourage readers to write or telephone us with any comments or queries that they may have.

H. BROOKES

EDITOR

1

[Isolation and concentration of staphylococcal enterotoxin B from foods by ultrafiltration.] Zum Abtrennen und Einengen von Staphylokokken-Enterotoxin B aus Lebensmitteln mit Hilfe der Ultrafiltration. [Thesis]
Schegger, G. L. A.
59pp. (1978) [many ref. De, en] Munich, Federal Republic of Germany; Fachbereich Tiermedizin, Ludwig-Maximilians-Universität

Ultrafiltration using standard cells with magnetic stirrers (produced by Amicon, Witten/Ruhr, Federal Republic of Germany) was a suitable procedure for concentrating dissolved staphylococcal enterotoxin B (SEB). Highest recovery of SEB (85–90%) was obtained with the UM-2 membrane. SEB could be successfully detected by Wadsworth's slide gel microtechnique [*International Archives of Allergy* (1957) 10, 355–360] if it was first extracted, isolated and concentrated by the following procedure: enzymic lipolysis; proteolysis of contaminating proteins with trypsin; acid precipitation of interfering food components; centrifugation; adjustment to pH 7.6 and buffering with barbitone; ultrafiltration with the XM-50 membrane for separation of high-mol.-wt. solutes; ultrafiltration with the UM-2 membrane; and freeze-drying. The procedure was tested on pasteurized milk (with 3.5 or 1.5% fat), Emmental cheese, minced meat and sausages deliberately contaminated with various levels of SEB. The enterotoxin was detected in all samples contaminated with 0.25 µg SEB (per 100 g or ml), and in 8 out of 10 samples contaminated with 0.1 µg SEB. ADL

2

Application of enzyme-linked immunosorbent assay for detection of staphylococcal entero toxins in food.
Kuo, J. K. S.; Silverman, G. J.
Journal of Food Protection 43 (5) 404–407 (1980) [16 ref. En] [Food Sci. Lab., US Army Natick Res. & Development Command, Natick, Massachusetts 01760, USA]

The enzyme-linked immunospecific assay (ELISA) is equally as sensitive as the radioimmunoassay (RIA) for detecting staphylococcal enterotoxins. The substitution of an enzyme in ELISA for ^{125}I in RIA results in a more stable reagent and enables quantitation spectrophotometrically or, with appropriate enzymes, semi-quantitation by visual estimation. Assay procedures identical in principle to RIA are employed with, of course, the necessity to avoid the presence of enzyme inhibitors. To date, ng quantities of staphylococcal enterotoxins A, B and C have been successfully measured in food extracts. In common with RIA, sensitivity is decreased by the presence of food materials. AS

3

[Parameters controlling the production of enterotoxins types A and B by *Staphylococcus aureus*, strain S6.] [Thesis: Estudo de parametros reguladores da producao de enterotoxinas estafilococicas tipos A e B pela linhagem *S. aureus* S6, 95pp., Pt]
Pereira, J. L.
Informativo Anual, Faculdade de Engenharia de Alimentos e Agricola, Universidad Estadual de Campinas No. 7, 32–35 (1979) [Pt, en]

This is a summary of a 1978 thesis from this University. Enterotoxins A and B produced by the same microorganism (strain S6, *S. aureus*) were compared using single gel diffusion method for toxin detection and quantification and a gradient incubator for growth culture studies. Temp. (20–45°C), pH (4.5–9.0), NaCl (0–12%) and effect of NaCl and pH together were the variables studied. Highest enterotoxin production occurred at optimum growth conditions 39.4°C and pH 7.0 (A, 0.80 µg/ml; B, 230.0 µg/ml). Highest rate of production was 12–15 h incubation for A, 18–24 h for B. 30–300 × more B was produced than A. Inhibition of both occurred below 20°C, and above 45°C, below pH 4.5, and above 12% NaCl. Production of the 2 toxins was affected differently by the parameters under consideration. [From En summ.] KME

4

Regulatory aspects of post-processing microbiological contamination of low-acid canned foods.
Brown, B. E.; Erdman, I. E.
Journal of Food Protection 43 (6) 477–483 (1980) [7 ref. En] [Bureau of Microbial Hazards, Health & Welfare Canada, Tunney's Pasture, Ottawa, Ontario K1A 0L2, Canada]

Various Canadian regulations pertinent to post-processing microbiological contamination of low-acid canned foods are reviewed. As an example of the dilemma presented to the regulatory agency, a typical case history is presented. The case concerns a canned fish product suspected of causing staphylococcal intoxication in 2 persons. Results of the investigation are presented and the reader is asked to be the judge. AS

5

Application of serological typing to the investigation of outbreaks of *Clostridium perfringens* food poisoning, 1970–1978.
Stringer, M. F.; Turnbull, P. C. B.; Gilbert, R. J.
Journal of Hygiene 84 (3) 443–456 (1980) [28 ref. En] [Food Hygiene Lab., Cent. Public Health Lab., Colindale Avenue, London NW9 5HT]

Serological typing was used as an epidemiological tool in the investigation of 524 outbreaks of *Clostridium perfringens* food poisoning in the UK and 37 outbreaks in other countries. 5554 (77%) of 7245 strains of *C. perfringens* associated with the 561 outbreaks were typable with the 75 Food Hygiene Laboratory antisera; in 354 (63%) of these outbreaks a specific serotype was established as being responsible for the outbreak. An assessment is made of the ability of 2 additional sets of antisera, prepared against 34 American and 34 Japanese strains of *C. perfringens*, to increase the number of strains which can be typed. The extent of cross-reaction between the 3 sets of antisera was determined and the results are discussed in relation to the source and history of the type strains. AS

6

Improved method for purification of enterotoxin from *Clostridium perfringens* type A.
Granum, P. E.; Whitaker, J. R.
Applied and Environmental Microbiology 39 (6) 1120–1122 (1980) [9 ref. En] [Norwegian Food Res. Inst., N-1432 As-NLH, Norway]

The purification procedure of *Clostridium perfringens* type A enterotoxin has been improved. The cell sonic extract was precipitated twice with ammonium sulphate, first 40% saturated to concentrate the enterotoxin and then 15% saturated. The 2 precipitations were followed by gel filtration on Sephadex G-100. The enterotoxin appeared to be homogeneous on 7% polyacrylamide gel electrophoresis after this 3-step purification procedure, with a recovery of 56% and a 12.3-fold purification. The solubility properties at different pH values, temp. and ammonium sulphate concn. are also given as basis for the purification procedure. AS

7

[Effect of enterotoxic staphylococci on formation of nitrosamines in muscle tissue of fish during salting.]
Zaleski, S.; Fik, A.; Daczkowska, E.; Koronkiewicz, A.; Stopikowska, I.
Medycyna Weterynaryjna 35 (1) 25–29 (1979) [12 ref. Pl, ru, en] [Inst. Tech. Zywnosci Pochodzenia Morskiego, AR, Szczecin, Poland]

Fresh Baltic herring in ice, and frozen cleaned mackerel were salted directly or after storage for 6 days at 1°C. Portions of 2 batches of each type of herring were salted with sea salt containing 600 p.p.m. nitrates and 0.2 p.p.m. nitrites, or with cooking salt containing 240 p.p.m. nitrates and 0.1 p.p.m. nitrites, or with fisherman's salt containing 210 p.p.m. nitrates and free from nitrites, each salt being used at 1 kg/4 kg fish. After 1 day, when brine had formed, a suspension of a *Staphylococcus aureus* strain was added to each 3-kg portion of herring to give an initial cell content of 4×10^6/ml brine; the portions were then stored at 6°C for 3 wk, and brine and herring were sampled at intervals. Mackerel was immersed before salting in brine containing *S. aureus* at 5×10^5 cells/ml, and were then salted with the 3 types of salt according to official instructions, the tubs being closed with weighted lids and stored at 22–28°C for 2 months; brine and mackerel were sampled at intervals. Survival of *S. aureus* during storage is graphically presented for all variants; all showed gradual disappearance of the contaminants. No nitrosamines were detected in any of the variants examined after 7-days storage. 112 samples of anchovies from Spain, Portugal and Yugoslavia were examined. No coagulase-positive staphylococci were detected in any of them; counts of anaerobic sporeformers ranged from 0 to 24/g, only 11.6% of samples containing >10/g. No nitrosamines were found in 12 of the 112 samples taken at random. SKK

8

Studies on the enterotoxigenicity of environmental *Escherichia coli*, belonging to serotypes normally considered enterotoxigenic.
Bettelheim, K. A.; Wilson, M. W.; Shooter, R. A.; O'Farrell, S. M.
Journal of Hygiene 84 (3) 411–414 (1980) [12 ref. En] [Nat. Health Inst., Dep. of Health, PO Box 7126, Wellington South, New Zealand]

15 strains of *E. coli*, isolated from chicken meat (7 strains) and other environmental samples, and belonging to serotypes normally considered enterotoxigenic, were studied for production of heat labile and heat stable enterotoxins. None of the chicken strains (belonging to serotypes 0.6.H/6. 0.6.H- and R.H16) produced either type of enterotoxin. 1 environmental strain produced heat labile enterotoxin and 1 was weakly positive in the heat stable enterotoxin assay. DIH

9

[Food poisoning. I. Toxins in natural foods.]
Lebensmittelvergiftung. I. Toxine in natürlichen Lebensmitteln. [Review]
Askar, A.; Morad, M. M.
Alimenta 19 (3) 59–66 (1980) [63 ref. De, en] [Inst. of Food Sci., Fac. of Agric., Univ. of Zagazig, Egypt]

This review discusses published information on naturally occurring toxins in foods and their effects. The sections include: nitrate in vegetables and drinking water, oxalic acid and anthraquinones in rhubarb; α-solanine in potatoes; gossypol in cottonseed; menthol in peppermint oil; 1,8-cineol in eucalyptus oil; safrole in *Sassafras officinale* oil; myristicin in nutmeg and dill seed; apiole in parsley seed oil; coumarin in woodruff, some fruits and touka beans; saponins in *Agrostemma githago*, soybeans and tea; lectins in beans and other Leguminosae; protease inhibitors in peas, beans, cereals and potatoes; favism from Faba beans; cyanide in bitter almonds, lima beans, cassava and linseed; mushroom toxins; caffeine and theophylline in coffee and tea; biogenic amines, e.g. tyramine in raspberries, citrus fruits, avocado and chocolate, serotonin in walnuts and pineapple, histamine in spinach and tomatoes, biogenic amines in fermented and bacterially spoiled foods (cheese, wine, sauerkraut, spoiled meat and fish); allergens in cereals, legumes, seeds, beans, milk, eggs, fish, food additives and preservatives, and food impurities (insects, yeasts and moulds, pollen). RM

10

Staphylococcal enterotoxin production in the presence of non-enterotoxigenic staphylococci.
Noleto, A. L.; Bergdoll, M. S.
Applied and Environmental Microbiology 39 (6) 1167–1171 (1980) [8 ref. En] [Inst. de Microbiol., Univ. Federal do Rio de Janeiro, Rio de Janeiro, Brazil]

Enterotoxigenic *Staphylococcus aureus* strains were grown with a non-enterotoxigenic strain in laboratory medium, in milk, and in ham. Differences in pigmentation were used to differentiate the enterotoxigenic strains from the non-enterotoxigenic ones. Enterotoxin was detectable in milk when the colony counts of the non-enterotoxigenic strain were 15 to 20 times greater than those of the enterotoxigenic ones and in ham when the ratio was 60 to 77:1. Enterotoxin was detectable in milk when the enterotoxigenic strains reached counts of colony-forming units of 10^7/ml, and in ham when the counts reached 10^8/ml. It may be necessary in some food poisoning outbreaks to examine many isolates (up to 50 or 60) for enterotoxin production to be able to detect the enterotoxigenic staphylococci. AS

11

Microbiological food poisoning.
Lechowich, R. V.
Association of Food and Drug Officials, Quarterly Bulletin 43 (1) 69–79 (1979) [En] [Dep. of Food Sci. & Tech., Virginia Polytechnic Inst. & State Univ., Blacksburg, Virginia 24061, USA]

Food poisoning by microbial activity, both infective and toxigenic, is discussed clinically and epidemiologically. Methods for the detection of food poisoning organisms are also described. The incidence of reported foodborne disease in the USA in 1975 is analysed in terms of the nature of the causative organism and the food vehicle. JRR

12

Determination of staphylococcal enterotoxin A in Cheddar cheese produced without starter activity.
Ibrahim, G. F.; Radford, H. M.; Fell, L. R.
Applied and Environmental Microbiology 39 (6) 1134–1137 (1980) [11 ref. En] [Dairy Res. Centre, Dep. of Agric., Richmond, NSW, Australia]

A method is described for radioiodination of staphylococcal enterotoxin A (SEA), yielding a preparation that is stable for 3 months at −21°C and with 55–76% incorporation of ^{125}I; specific activity was 3.5–5.5 μCi/μg enterotoxin. Experimental Cheddar cheeses were manufactured from milk inoculated with 2 enterotoxin A-producing strains of *Staphylococcus aureus;* starter streptococci were added together with a specific bacteriophage to arrest starter activity. Analysis of SEA in the experimental cheeses [see FSTA (1979) **11** 3C134] was unsatisfactory because of gelling in the assay tubes. However, when 0.05M tris buffer (pH 7.5) was substituted for the 0.15M phosphate buffer in the assay system, no gelling occurred and the method was shown to have a high degree of accuracy and precision. The lowest concn. of enterotoxin that could be detected was 0.5 ng/ml cheese extract. MEG

13

Enterotoxin production and thermal resistance of *Yersinia enterocolitica* in milk.
Francis, D. W.; Spaulding, P. L.; Lovett, J.
Applied and Environmental Microbiology 40 (1) 174–176 (1980) [18 ref. En] [Div. of Microbiol., FDA, Cincinnati, Ohio 45226, USA]

3 of 36 raw milk isolates of *Yersinia enterocolitica* produced enterotoxin in milk at 25°C, but not at 4°C. No strain tested could survive pasteurization. AS

14

Comparison of direct serial dilution and most-probable-number methods for determining endotoxins in meats by the *Limulus* amoebocyte lysate test.
Seiter, J. A.; Jay, J. M.
Applied and Environmental Microbiology 40 (1) 177–178 (1980) [2 ref. En] [Dep. of Biol. Sci., Wayne State Univ., Detroit, Michigan 48202, USA]

When the endotoxin content of ground beef was determined by direct serial dilution and by three-tube MPN methods, the results were not significantly different, although the latter method provided more specific values for individual samples. AS

15

Food-borne illness – a personal approach.
Jackson, H.
Agricultural and Forestry Bulletin 1 (4) 12–16 (1978) [En]

The main causes of food-borne illness are briefly considered and advice on how the individual can minimize personal risks is given. Topics include food-borne illness, natural toxicants in foods, chemical toxicants in foods and microbiological food-borne illness (*Salmonella* spp., *Staphylococcus aureus, Clostridium perfringens* and *Cl. botulinum).* Recommendations given are listed under the following headings: temp. control, preparation of food and personal hygiene. SP

16

[Formation of toxins of botulism-producing spores and their heat stability in juice from machine harvested tomatoes.]
Mordvinova, S. A.; Belousova, M. V.; Titarenko, I. O.
Konservnaya i Ovoshchesushil'naya Promyshlennost' No. 4, 37–40 (1980) [Ru] [VNIPKI 'Konservpromkompleks', USSR]

Potential growth and formation of toxins in *Clostridium botulinum* type A and B spores in machine harvested tomatoes juice with pH ranging between 4.2 and 4.9 were studied. Calculated coeff. of heat resistance of these spores are given. The F-effect value at all investigated temp. rose substantially as the pH increased. A distinct correlation was found between $F_{125°C}$ and pH ($r = 0.96$). At lower temp. (121° and 110°C), a low pH required an appreciable rise in the sterilization effect. STI

17

[Toxinogenesis of *Clostridium botulinum* type B during maturation of soft cheese.]
Billon, J.; Guerin, J.; Sebald, M.
Lait **60** (597) 329–342 (1980) [5 ref. Fr, en] [Lab. Centra d'Hygiene Alimentaire, 43 rue de Dantzig, 75015 Paris, France]

Soft cheeses were prepared from milk inoculated with *Cl. botulinum* B and *Cl. ghoni* spores (each at 1500/l). After storage for 11 wk at 4, 12 or 20°C, no botulism toxin could be detected in the cheeses. Storage of normal cheeses on straw mats contaminated with 1000 *Cl. botulinum* spores/cm² led to the production of toxin in the rind but not in the body of the cheese. The toxin content of the rind decreased with increasing storage time. Results indicate that soft cheeses should not be placed on unsterilized straw mats when offered for sale. MEG

18

Durability of enterotoxin B in liquid whole milk against ultra-high temperature pasteurization.
Haruta, M.; Murakami, H.
Bulletin of the College of Agriculture and Veterinary Medicine, Nihon University [Nihon Daigaku Nojoigakubu Gakujutsu Kenkyu Hokoku] 37 (55) 31–35 (1980) [11 ref. En, ja] [Dep. of Food Tech., Coll. of Agric. & Vet. Med., Nihon Univ., Tokyo, Japan]

Crude enterotoxin B from the filtrate of a 24-h culture of *Staphylococcus aureus* ATCC 14458 was added at 54.04 μg/ml to 40 l raw milk, and subjected to UHT

treatment. Recoveries of toxin from the holding tank after pre-heating for 3 and 6 min, resp. at 90°C were 18.5 and 19.7%, whilst in the finished product, sampled at 5-min intervals at the outlet, recoveries ranged from 35.5 to 37.1% (4 samples). This suggested that some reactivation occurred following heating at 121°C for 2 s: reactivation was confirmed by heating purified enterotoxin B at 90°C then 121°C, and was even more evident when purified enterotoxin A was heated at 60°C then 80°C. CDP

19

Isolation and characterisation of *Staphylococcus aureus* from dairy sources. [Lecture]
Rea, M.; O'Connor, F.; Daly, C.
Irish Journal of Food Science and Technology 3 (1) 61 (1979) [En] [Microbiol. Dep., An Foras Taluntais, Moorepark, Fermoy, Co. Cork, Irish Republic]

Strains of *Staph. aureus* isolated from cows' udders, mastitis milk and dried milk samples were examined for their biochemical characteristics and toxin-producing ability. Strains from dried milk were egg-yolk positive on Baird-Parker medium, coagulase-positive, and produced heat-stable nuclease, but only 4 samples tested to date have produced enterotoxins A, B, C, D or E. [See FSTA (1981) 13 3A120.] CDP

20

Enzyme immunoassay for staphylococcal enterotoxin A.
Kauffman, P. E.
Journal of the Association of Official Analytical Chemists 63 (5) 1138–1143 (1980) [18 ref. En] [Div. of Microbiol., FDA, 1090 Tusculum Avenue, Cincinnati, Ohio 54226, USA]

An enzyme immunoassay procedure specifying alkaline phosphatase-labelled enterotoxin A was used to determine enterotoxin in standardized solutions and food extracts. *Staphylococcus aureus* Cowan 1 cells were used to separate unbound from antibody-bound enterotoxin. The method is sensitive to 2 ng enterotoxin A/ml; cross reactions with other staphylococcal enterotoxins did not interfere with the specificity. The method is sensitive and precise enough to serve as a reliable alternative to radioimmunoassay for enterotoxin A. AS

21

Variation in food microbiological tests used to evaluate analyst performance.
Peeler, J. T.; Messer, J. W.; Leslie, J. E.; Houghtby, G. A.
Journal of Food Protection 43 (9) 729–732 (1980) [12 ref. En] [Div. of Microbiol., FDA, Cincinnati, Ohio 45226, USA]

Procedures for evaluating analyst performance in state and federal milk and food laboratory quality assurance programs depend on the estimates of variation for the methods used. The total components of variance for a method consist of replicate error, among-analysts variance, and analyst-sample interaction components. 11 methods were evaluated in this study. Total variance estimates of milk analytical procedures for the Standard Plate Count, plate loop count, coliform plate count, direct microscopic somatic cell count, electronic somatic cell count and Wisconsin mastitis test were 0.01045, 0.01371, 0.01590, 0.01265, 0.00504 and 4.06, resp. Estimates of the logarithmic total variance of food analytical procedures for the aerobic plate count, coliform MPN, *Escherichia coli* MPN, faecal coliform MPN and *Staphylococcus aureus* MPN were 0.00853, 0.10205, 0.14705, 0.14780 and 0.24245, resp. The study showed that current analyst performance levels used by state and federal laboratory quality assurance programs are satisfactory. AS

22

[Food poisoning by *Bacillus cereus*.] [Review]
D'Aubert, S.; Abbati, P.; Cantoni, C.
Industrie Alimentari 19 (12) 913–921, 926 (1980) [102 ref. It, en] [Istituto di Ispezione degli Alimenti di Origine Anim. Univ. degli Studi, Milan, Italy]

Aspects covered in this review include: characteristics of *B. cereus*, antigen factors, toxin synthesis and release, identification, and pathogenicity. Additionally, a case of food-borne *B. cereus* poisoning (from a chicken dish), including all the analytical stages, is described. HBr

23

Thermonuclease test as a rapid screening method for the likely presence of staphylococcal enterotoxins in dairy products.
Batish, V. K.; Ghodeker, D. R.; Harish Chandra
Indian Dairyman 32 (3) 255–257 (1980) [En] [Div. of Microbiol., Nat. Dairy Res. Inst., Karnal, Haryana-132 001, India]

A rapid and inexpensive screening procedure has been developed based on assay of thermonucleases which are produced by a large number of enterotoxigenic strains of *Staphylococcus aureus*. The test can be carried out either with an overnight brain-heart infusion culture of the microorganism isolated from the food sample or with the crude enzyme extract obtained from the food sample by adjusting the pH to 4.5, centrifuging at 20 000 x g_n for 15 min and adding trichloroacetic acid to the supernatant. The precipitate is treated with 0.05M tris buffer (pH 8.5) and boiled for 15 min. 0.01 ml of heat-treated sample are added to wells cut in Toluidine Blue DNA agar plates. After incubation at 37°C, the presence of thermonuclease is indicated by the formation of pink zones around the wells. For quantitative analysis of the enzyme, a standard curve is plotted using pure micrococcal DNAase. CFTRI

24

[Determination of the count of coagulase-positive staphylococci in fishery products within 24 hours.]
Toepoel, L.; Spreekens, K. J. A. van
Voedingsmiddelentechnologie 13 (18) 11–13 (1980) [5 ref. Nl, en] [CIVO-Tech., Afdeling Inst. voor Visserijprodukten TNO, Ijmuiden, Netherlands]

Limitations of the use of Baird-Parker's medium for detection and enumeration of coagulase-positive staphylococci in foods are discussed, with special reference to the duration of incubation and the coagulase test. A new rapid procedure is described,

based on use of a double layer plate (modified Hauschilds bovine fibrinogen agar covered with a layer of Stadhouder's porcine plasma agar). Inoculated plates are incubated for 24 h at 37°C; coagulase-positive staphylococci may be identified without further staining. Studies were conducted on samples of various types of fish, shrimp, and mussels by the above method, by the standard method using Baird-Parker medium, and using brain-heart infusion agar. The results show the new test to be highly specific, to give clear results and to give results comparable to those with conventional media, but 1-2 days faster. AJDW

25

The bacteriological quality of minced beef in the UK.
Roberts, T. A.; Britton, C. R.; Hudson, W. R.
Journal of Hygiene 85 (2) 211-217 (1980) [20 ref. En] [Agric. Res. Council, Meat Res. Inst., Langford, Bristol BS18 7DY, UK]

Studies were conducted on the bacteriological quality of a total of 162 samples of minced beef, collected from 3 supermarkets, 3 intermediate-sized chain butchers and 3 small family butchers in each of 3 geographical regions of the UK, samples from each shop being taken at both warm and cool times of the year. The temp. and pH of the minced meat at the time of purchase were determined, together with fat content, total viable counts at 20° and 37°C, Enterobacteriaceae counts at 17° and 37°C, and counts of faecal streptococci, *Staphylococcus aureus*, *Clostridium perfringens*, and presumptive coliforms. Tables of results (mean values and ranges) are given. The results show bacteriological quality to be generally acceptable. Comparison with literature data show the microbiological quality of minced beef in the UK to be very similar to that of minced beef in the USA and Canada; little change in bacteriological quality has occurred over the past 60 yr. Little effect of shop type or season on microbiological quality was observed. In small and intermediate shops, counts of faecal streptococci were higher and counts of *Staph. aureus* were lower in the warm than the cool season; in intermediate size butchers and supermarkets, counts of *Cl. perfringens* were higher in the cool than in the warm season. These differences are, however, of no practical importance. Bacterial counts tended to increase with increasing pH at purchase; no significant relation of bacteriological quality to fat content or temp. at purchase was observed. AJDW

26

Enterotoxigenicity of *Staphylococcus aureus* strains isolated from chickens.
Shiozawa, K.; Kato, E.; Shimizu, A.
Journal of Food Protection 43 (9) 683-685 (1980) [17 ref. En] [Dep. of Public Health, Hokkaido Univ., Sapporo 060, Japan]

To determine whether *S. aureus* strains isolated from chickens were potential causes of human intoxications, 586 strains from diseased and healthy chickens obtained from 52 farms in several districts of Japan were examined. Of these, 16 strains produced staphylococcal enterotoxins. One-half of the enterotoxigenic strains were isolated from diseased chickens exclusively suffering from vesicular dermatitis, and another half were from healthy chickens. The enterotoxin types D and C were dominant in the strains from diseased and healthy chickens, resp. The enterotoxigenic strains differed from the nonenterotoxigenic strains in several of their biochemical properties, and in their susceptibility to International human phages, and insusceptibility to Shimizu's avian phages group I which lyse most of the staphylococci of chicken origin. These differences may suggest that the enterotoxigenic strains of chicken origin were proper to humans but not to chickens. AS

27

Incidence of *Clostridium botulinum* in commercial bacon.
Hauschild, A. H. W.; Hilsheimer, R.
Journal of Food Protection 43 (7) 564-565 (1980) [18 ref. En] [Bureau of Microbial Hazards, Health & Welfare Canada, Tunney's Pasture, Ottawa, Ontario, K1A 0L2, Canada]

Four 75-g samples from each of 104 retail packages of bacon were tested for *Cl. botulinum* by adding strips to Mason jars containing freshly-prepared TPGY medium [see Kautter & Lilly, FSTA (1971) 3 1R26]. Toxin was found in 1 of 208 unheated cultures after incubation for 1 wk at 35°C, but in none of 208 cultures heated to 75°C for 20 min prior to incubation. The toxic culture was neutralized by a combination of botulinal types A and B antisera, but not by either antiserum alone. No toxin was found when an additional 75-g portion from the same package of bacon was tested without heating. The test procedure used was able to recover all vegetative cells and about 40% of spores in unheated culture, and most of the spores in heated cultures. The MPN of *Cl. botulinum* in commercial bacon is estimated to be 0.064/kg with 90% confidence limit of 0.0004 to 0.478/kg. CDP

28

Effect of additives and ripening parameters on growth and toxin production of *Clostridium botulinum*. [Lecture]
Incze, K.; Delenyi, M.
Proceedings of the European Meeting of Meat Research Workers No. 25, 12.1:877-12.1:882 (1979) [10 ref. En, de, fr, ru] [Hungarian Meat Res. Inst., Budapest, Hungary.]

Batches of raw sausage were made with 600 p.p.m. KNO_3, 150 p.p.m. $NaNO_2$, or no nitrite or nitrate. Each sausage was injected with 10^3 spores of *Clostridium botulinum*, either at the centre or the end. Samples were taken at weekly intervals during ripening, and phosphate buffer extracts were tested for toxin by intraperitoneal injection into mice. The results showed toxin formation during the early period of ripening in the samples made with neither nitrate or nitrite, but not in those containing either curing agent. After several wk of ripening, toxin formation ceased and the toxin already formed was inactivated. Similar inactivation of toxin was observed when sausages were injected with preformed toxin rather than *Cl. botulinum* spores. The mechanism of inactivation of *Cl. botulinum* toxin is under investigation. [See FSTA (1981) 13 5S668.] STI

29

Single radial immunodiffusion method for screening staphylococcal isolates for enterotoxin.
Meyer, R. F.; Palmieri, M. J.
Applied and Environmental Microbiology 40 (6) 1080–1085 (1980) [7 ref. En] [FDA, Brooklyn, New York 11232, USA]

A direct system for screening large numbers of staphylococcal isolates for enterotoxin production was developed. The system employs polyvalent (serotypes A, B, C, D and E) immunodiffusion assay slides in conjunction with a multiple-culturing system for toxin production. With the combined system, as many as 50 cultures can be screened simultaneously on a single assay slide having a sensitivity of about 0.3 μg/mL The system should be useful for detecting potential enterotoxin in foods containing a predominance of non-enterotoxigenic strains. AS

30

[Bacterial food intoxication from soaked cereal grain products.] Bakterielle Lebensmittelintoxikationen durch eingeweichte Getreidevollkornprodukte.
Untermann, F.
Getreide, Mehl und Brot 33 (11) 294–295 (1979) [4 ref. De] [Landesanstalt für Vet. & Lebensmittelhygiene, Invalidenstrasse 60, 1000 Berlin 21]

Because of fears that softening cereal grain foods for consumption by long soaking times at room temp. may allow toxin production, especially staphylococcal enterotoxin, 6 commercial grain products were inoculated with staphylococcal strains producing either enterotoxin A or B and incubated at 30°C for 24 h. With an initial inoculum of 1–2 × 10^3/g DM final staphylococcal counts were 10^5–10^6/g, but no enterotoxin was detected. No enterotoxin was produced unless inoculum size was ≥ 10^5/g. Under normal conditions there is no danger of staphylococcal enterotoxin formation in such products, although softening for shorter times or at refrigerator temp. is recommended to minimize risks. DIH

31

Toxin production by *Clostridium botulinum* type E in smoked fish in relation to the measured oxidation reduction potential (Eh), packaging method and the associated microflora. (In '*Advances in fish science and technology*' [see FSTA (1981) 13 6R300].) [Lecture]
Huss, H. H.; Schaeffer, I.; Pedersen, A.; Jepsen, A.
pp. 476–479 (1980) [24 ref. En] [Tech. Lab., Min. of Fisheries, Tech. Univ., Lyngby, Denmark]

3 experiments were conducted on hot-smoked herring. The first involved intramuscular inoculation in the loin with 10^2 *Cl. botulinum* type E spores/g and also, in some cases, with 10^3 of a specific (unnamed) spoilage organism/g. The 2nd experiment involved surface contamination with the specific spoilage organism and/or type E spores, both at levels of 10^3/g, while the 3rd experiment involved surface inoculation with 5 × 10^1 type E spores/g. The inoculated samples and uninoculated controls were then packaged by one or more of the following methods: vacuum-packed singly in polyamide-laminated bags (Rylothene-S); air-packed in polyethylene bags; and packed in Rylothene-S bags containing different proportions of N_2 (0.29–99.92%), CO_2 (0–99.58%) and O_2 (0.09–99.70%). The packaged samples were stored at 15°C for up to 16 days and examined at intervals for toxin production and for changes in gas composition, Eh and partial pressure of O_2. The Eh levels found (≤ 250 mV) did not inhibit the initiation of growth and toxin production by the spores. Results also indicated that vacuum-packing and/or surface contamination with the spoilage organism enhanced and stabilized toxin production in herring surface contaminated with spores. The safest packaging method with regard to toxin production was found to be packaging in an equal mixture of O_2 and CO_2. The most alarming finding was that herring surface contaminated with 10^2 type E spores/g and packaged either in air or in pure O_2 can become toxic within 6–9 days at 15°C. [See also FSTA (1980) 12 3R177.] JA

32

Enterotoxin formation by *Clostridium perfringens* type A in a defined medium.
Labbe, R. G.
Applied and Environmental Microbiology 41 (1) 315–317 (1981) [12 ref. En] [Dep. of Food Sci. & Nutr., Food Microbiol. Lab., Univ. of Massachusetts, Amherst, Massachusetts 01003, USA]

Enterotoxin was produced by 9 of 10 strains of *Clostridium perfringens* type A when grown in a defined medium. Additional dextrin increased the amount of enterotoxin in extracts of sporulating cells of strain NCTC 10239. AS

33

Food toxins. [Review]
Sreenivasamurthy, V.
Journal of Food Science and Technology, India 17 (1/2) 89–94 (1980) [51 ref. En] [Cent. Food Tech. Res. Inst., Mysore-570 013, India]

The review covers natural toxins inherent in foods, e.g. trypsin inhibitor, haemagglutinins, amylase inhibitor, and lathyrogens; and acquired toxins e.g. bacterial toxins (from staphylococci, *Clostridium perfringens* and *Bacillus cereus*) and mycotoxins. The implications of these toxins and their remedial measures are indicated. CFTRI

34

[Examination of honeys for botulin toxin.]
Untersuchungen von Honigproben auf Botulinustoxin.
Hartgen, H.
Archiv für Lebensmittelhygiene 31 (5) 177–178 (1980) [11 ref. De, en] [Fasangartenstrasse 157, 8000 Munich 90, Federal Republic of Germany]

210 commercial samples of honey from S. Bavaria were examined for *Clostridium botulinum* contamination by anaerobic incubation in liver broth and for botulin toxin by injection of sterile filtrate into test animals (mice). None of the animals showed any symptoms of botulin intoxication, showing that all samples were negative for botulin toxins A, B and E and free from toxigenic pathogens. RM

35

Detection of mitogenic activity of staphylococcal enterotoxin A in foods.

Stelma, G. N., Jr.; Archer, D. L.

IRCS Medical Science 8 (6) 347 (1980) [5 ref. En] [Div. of Microbiol., FDA, Cincinnati, Ohio 45226, USA]

A highly sensitive biological assay has been developed with antigenic specificity based on neutralization of mitogenic potential. *Staphylococcus aureus* 100 (producer strain for staphylococcal enterotoxin A) and *Staph. aureus* 184 (a non-enterotoxigenic strain) were grown in baby food (chicken in chicken broth) and in sterile reconstituted dried skim-milk at 37°C. Removal of inhibitory factors from food extracts by dialysis permitted the detection of 10-fold lower amounts of staphylococcal enterotoxin A (SEA). In each food and in the culture medium, min. detectable SEA was produced by approx. 10^4 to 5×10^4 colony forming units (CFU)/ml. All the mitogenic activity produced in the food samples was neutralized by antibody to SEA. Samples of both foods in which *Staph. aureus* 184 was allowed to grow to densities greater than 10^8 EFU/ml contained no detectable mitogenic activity. The ability of antiserum prepared against purified SEA to neutralize all of the mitogenic activity detected in the food extracts and the failure of the non-enterotoxigenic *Staph. aureus* 184 to produce mitogenic activity in the foods are evidence that this test is specific for SEA. VJG

36

Persistence of *Clostridium botulinum* type B on a cattle farm after an outbreak of botulism.

Notermans, S.; Dufrenne, J.; Oosterom, J.

Applied and Environmental Microbiology 41 (1) 179–183 (1981) [11 ref. En] [Lab. for Zoonoses & Food Microbiol., Nat. Inst. of Public Health, 3720 BA Bilthoven, Netherlands]

37

Effects of various concentrations of sodium nitrite and potassium sorbate on *Clostridium botulinum* toxin production in commercially prepared bacon.

Sofos, J. N.; Busta, F. F.; Bhothipaksa, K.; Allen, C. E.; Robach, M. C.; Paquette, M. W.

Journal of Food Science 45 (5) 1285–1292 (1980) [32 ref. En] [Dep. of Food Sci. & Nutr., Univ. of Minnesota, St. Paul, Minnesota 55108, USA]

The study consisted of 5 treatments including formulations with or without sodium nitrite (120 p.p.m.) or potassium sorbate (0.26%) or both nitrite (40, 80 p.p.m.) and sorbate (0.26%). Packages (300 per treatment) of commercially prepared bacon were inoculated with *Clostridium botulinum* spores from 10 strains (5 type A and 5 type B) and temp. abused at 27°C. Uninoculated packages (100 per treatment) were also abused. The packages were visually checked for gas production during a 60-day incubation period and tested for botulinal toxin. Spore and vegetative cell counts, aerobic total plate counts, product pH, residual nitrite depletion, and sorbate levels were also monitored. Toxic samples frequently occurred without gas, and many samples showing gas were nontoxic. Added sorbate or added nitrite extended the time to detection of first gas-containing and first toxic samples. A combination of sorbate (0.26%) with reduced nitrite levels (40, 80 p.p.m.) extended this time further. None of the uninoculated packages was toxic, while the total number of toxic inoculated packages decreased with nitrite or sorbate in the formulations. 90% of the samples from the control treatment became toxic during the 60-day incubation period; 58.8% from the treatment with 0.26% sorbate; 22.0% from the treatment with 40 p.p.m. nitrite and 0.26% sorbate; none from the treatment with 80 p.p.m. nitrite and 0.26% sorbate; and 0.4% from the treatment with 120 p.p.m. nitrite. Low nitrite-sorbate combinations were thus effective in delaying botulinal toxin production in temp. abused bacon. IFT

38

Principles of food poisoning – and its control.

Turnbull, P. C. B.

South African Food Review 7 (5) 113–114, 117, 119–121, 123–124 (1980) [8 ref. En] [Cent. Public Health Lab., London, UK]

This report on food poisoning in various countries includes the following sections: aetiology; foods involved; characteristics of the different types of food poisoning; bacterial counts, microbiological standards and food poisoning; specific food poisoning organisms; control measures. Several tables are provided. LH

39

[Staphylococci in dairy products.]

Lück, H.

South African Journal of Dairy Technology 12 (2) 63–65 (1980) [5 ref. Af] [Navorsingsinst. vir Vee & Suiwelkunde, Irene 1675, South Africa]

This article discusses staphylococcal food poisoning and describes the main characteristics of staphylococci. Details are given of a procedure for detecting and counting coagulase-positive staphylococci, using trypticase soy broth (with 10% NaCl) or Giolotti-Cantoni medium for preliminary enrichment, followed by incubation for 24 h at 37°C on Baird-Parker medium; large black colonies can be confirmed as *Staphylococcus aureus* by a plasma coagulation test. *Staphylococcus aureus* must not exceed 100/ml in pasteurized milk for manufacture, and 10/ml in ice cream and in milk and cream for consumption raw; it must be absent in 1-g samples of pasteurized market milk, pasteurized cream and dried milk, and in 0.1-g samples of 1-month-old cheese. These standards must be satisfied in 4 out of 5 samples. ADL

40

The stability of *Clostridium botulinum* type E toxin in salty and/or acid environment.

Huss, H. H.; Petersen, E. R.

Journal of Food Technology 15 (6) 619–627 (1980) [13 ref. En] [Tech. Lab., Min. of Fisheries, Tech. Univ., Lyngby, Denmark]

The stability of preformed *Clostridium botulinum* type E toxin in sterile buffer- and salt-solutions and in

some commercial fish products was examined. It was found that progenitor toxin is stable for weeks at room temp. in sterile culture filtrate, spoiling fish and in low acid fish products and that it is unaffected by sterile saturated NaCl solutions and in salted fish. In high acid feed fish (fish silage pH 2–4) some inconsistent increased toxin titres were observed. The activated toxin, on the other hand, decreased and increased in titre during several wk of storage in culture filtrate with added trypsin. In sterile NaCl solutions the titre decreased by a factor of 10 to that of a progenitor toxin, but in spoiling raw and salted fish toxicity was lost when pH exceeded 7.5. The public health significance of these results is discussed. AS

41

Take-away foods – microbiological aspects.
Christian, J. H. B.
CSIRO Food Research Quarterly 40 (2) 25–28 (1980) [3 ref. En] [CSIRO Div. of Food Res., North Ryde, NSW, Australia]

Important characteristics are given for 4 types of bacteria: *Staphylococcus aureus, Salmonella* sp., *Clostridium perfringens,* and *Bacillus cereus,* which are usually responsible for food poisoning by take-away foods. Consideration is given to the possible microbiological hazards of: hot take-aways (meat pies, rotisseried chicken, deep fried chicken, hamburgers, stews and casseroles, and batters); and cold take-aways. Steps which should be taken to ensure microbiological safety are discussed. VJG

42

[Occurrence of enterotoxigenic staphylococci in milk and milk products.] Vorkommen von enterotoxinbildenden Staphylokokken in Milch und Milchprodukten. [Lecture]
Zaadhof, K.-J.
Deutsche Tierärztliche Wochenschrift 87 (4) 144–145 (1980) [De] [Lehrstuhl für Hygiene & Tech. der Milch der Ludwig-Maximilians-Univ., Munich, Federal Republic of Germany]

In market milk, the most likely source of enterotoxin-producing staphylococci is post-pasteurization contamination by man and/or equipment, and subsequent insufficient cooling. Elimination of an antagonistic flora promotes the multiplication of staphylococci. In cheese, lack of acid development and bacteriophage increase the risk of enterotoxin production. [See FSTA (1981) 13 9P1584.] BR

43

A comparative bacteriologic study on coagulase-positive staphylococci isolated from man and animals in Assiut.
Nashed, S. M.; Zaki, M. M.; Nasr, S.; El-Sokkary, A.
Veterinary Medical Journal 25, 11–16 (1977, publ. 1979) [22 ref. En] [Min. of Agric., Assiut, Egypt]

A total of 295 coagulase-positive staphylococci (162 strains isolated from cows' milk and 133 strains from human pyogenic lesions) were collected in Assiut and a comparison made of the biochemical characteristics of the bovine and human strains. Most of the bovine strains (95%) produced β-haemolysin compared with only 13.5% of human strains; few bovine strains (9.8%) produced fibrinolysin whereas 82% of human strains were fibrinolysin producers. Since pathogenic staphylococci were isolated from normal cows' milk as well as mastitic milk, the cow can be regarded as a potential source of pathogenic staphylococci for man. MEG

44

[Gram-negative bacterial endotoxin (lipopolysaccharide) in milk and dairy products.]
Moller-Madsen, A.; Mikkelsen, T.; Hansen, K.
Beretning fra Statens Forsogsmejeri No. 240, 16pp. (1980) [13 ref. Da, en] [Statens Forsogsmejeri, Hillerod, Denmark]

Log average contents of procaryotic lipopolysaccharides determined by the Limulus test in various products (ng/ml, with range in brackets) were 0.4 (<0.5–5) in 18 farm milk samples; 1 (<0.5–5) in 9 fresh samples of liquid milk products (market milk, buttermilk, ymer, cream, etc.); 50 (10–1000) in 41 whole and skim milk samples stored for 6 days at 5°C; 20 (5–50) in 9 fresh samples of fruit yoghurt; 50 (10–500) in 18 samples of cream for buttermaking; 11 000 (1000–50 000) in 24 dried milk samples; 50 (1–1000) in 31 samples of hard and semi-hard Danish cheese, mould cheese and Feta cheese; 800 (100–10 000) in 4 samples of butter, with or without herbs; 150 (50–1000) in 16 samples of preserved fruit for yoghurt; and 30 000 (10 000–100 000) in 5 samples of dried herbs for butter (dill, parsley, etc.). Of the 18 farm milk samples, 9 contained ≤0.5 and 9 contained ≥1.0 ng lipopolysaccharide/ml, with total bacterial counts of 11 000 and 40 000/ml, 2500 and 9000 psychrotrophs/ml, 3 and 44 coliforms/ml, and 100 and 1100 penicillin-resistant bacteria/ml, resp. The Limulus test (using an aqueous extract of amoebocytes from *Limulus polyphemus*) was found to be a rapid and accurate method for determining lipopolysaccharides produced by Gram-negative bacteria, and thus for monitoring the hygienic quality of dairy products at all stages of the production process. ADL

45

[Effects of water activity and pH on shelf-life and the toxin production of fish sausage inoculated with spores of *Clostridium botulinum* type A.]
Sasajima, M.; Matsushita, A.; Katayama, K.; Kobayashi, H.; Arai, K.; Yokoseki, M.; Mitsukawa, M.
Bulletin of the Tokai Regional Fisheries Research Laboratory [Tokai-ku Suisan Kenkyusho Kenkyu Hokoku] No. 100, 45–51 (1979) [11 ref. Ja, en]

Fish sausage was prepared, adjusted to a_w 0.94 with sodium malate, sorbitol and an amino acid mixture, adjusted to pH 6.08–7.36 with glucono-δ-lactone and fumarate, inoculated with *Clostridium botulinum* type A strain 190 spores, filled into Saran casings, and heated in water for 50 min at 95°C. Samples were stored at 30°C for ≤77 days; at intervals, pH, aerobic and anaerobic counts, organoleptic properties and presence vs. absence of toxin were evaluated. Fish sausage with 1.8% NaCl underwent toxin formation at pH 6.5, but

not at pH 6.0–6.3; however, spoilage occurred over the latter pH range. Reduction of a_w considerably increased shelf-life (to ≥63 days at a_w 0.94, pH 6.0, or ≤42 days at pH 6.5). Botulinum toxin formation was not observed in samples adjusted to low a_w, even after spoilage. These results were confirmed in test tube studies. [From En summ.] AJDW

46

[The effect of packaging style on the production of *Clostridium botulinum* type A toxin in kamaboko.]
Sasajima, M.; Shiba, M.; Matsushita, A.; Arai, K.; Yokoseki, M.; Takamizawa, M.
Bulletin of the Tokai Regional Fisheries Research Laboratory [Tokai-ku Suisan Kenkyusho Kenkyu Hokoku] No. 95, 85–89 (1978) [7 ref. Ja, en]

Studies were conducted to evaluate the growth and toxin formation capacity of *Clostridium botulinum* type A in kamaboko. Trials were conducted on unpackaged kamaboko, and kamaboko packaged in O_2-permeable casings. The kamaboko samples were inoculated with 10^2 or 10^6 spores/g, and stored for ≤6 days at 30°C. Tables of data are given for redox potentials, pH, organoleptic quality scores, aerobic and anaerobic counts and presence/absence of toxin (evaluated by mouse assay). The results show that toxin formation of *Cl. botulinum* toxin is possible regardless of redox potential, if putrefactive aerobic and/or anaerobic bacteria are present in the product. This capability of *Cl. botulinum* to grow and form toxin in kamaboko at highly positive Eh is discussed; it may be attributable to O_2-scavenging by aerobic or facultatively anaerobic bacterial. [From En summ.] AJDW

47

[Pathogenic microorganisms in Spanish pre-cooked frozen foods containing fishery products.]
Polo, L. M.; Pozo, R.; Herrera, A.; Jordano, R.; Jodral, M.
Anales de Bromatologia 32 (1) 49–59 (1980) [many ref. Es, en] [Fac. de Vet., Univ. de Cordoba, Cordoba, Spain]

179 samples of Spanish cooked frozen sea foods were examined for the presence of enteropathogenic *Escherichia coli*, salmonellae, shigellae, pathogenic staphylococci, *Clostridium perfringens* and *Vibrio parahaemolyticus*. Tabulated results showed that 3 serotypes of *E. coli* were identified (in cod croquettes, hake croquettes and cakes); 23.55% of all samples contained salmonellae, only 1 sample a shigella, 7.2% pathogenic staphylococci; 93.8% of samples contained <10 *Cl. perfringens*/g; and no *V. parahaemolyticus* was detected in any sample. The following limits are recommended: no salmonellae or shigellae in 25 g, no pathogenic staphylococci in 5 g, and <10 *Cl. perfringens* in 1 g of food. [See also preceding abstr.] RM

48

[Food poisoning caused by *Clostridium perfringens*.] [Review]
Cygan, Z.; Prost, E.
Medycyna Weterynaryjna 35 (8) 449–453 (1979) [71 ref. Pl] [Zaklad Higieny Weterynaryjnej, Lublin, Poland]

Aspects covered include: history of the recognition of involvement of *C. perfringens* in human food poisoning; aetiology; reservoirs of infection; pathogenesis and course of infection; epidemiology; and prophylactic measures for foods. DIH

49

Nature of intracellular type A botulinum neurotoxin.
Krysinski, E. P.; Sugiyama, H.
Applied and Environmental Microbiology 41 (3) 675–678 (1981) [16 ref. En] [Food Res. Inst., Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

50

[*Clostridium perfringens* as a cause of human food poisoning.] [Review]
Cygan, Z.; Prost, E.
Medycyna Weterynaryjna 35 (10) 577–583 (1979) [114 ref. Pl] [Zaklad Higieny Weterynaryjnej, Lublin, Poland]

Aspects covered include: basic characteristics of *C. perfringens;* sporogenesis; enterotoxigenesis; enterotoxin characteristics; mechanism of action of the enterotoxin; and other cytotoxic factors. DIH

51

Enterotoxigenic bacteria in food and water from an Ethiopian community.
Jiwa, S. F. H.; Krovacek, K.; Wadström, T.
Applied and Environmental Microbiology 41 (4) 1010–1019 (1981) [57 ref. En] [Dep. of Bact. & Epizootology, Swedish Univ. of Agric. Sci., Biomedicum, Box 583, S-751 23 Uppsala, Sweden]

Food (vegetables, raw fish, raw meat products) and water samples obtained from market stalls and street vendors in Addis Ababa, Ethiopia, in 1977 were screened for the presence of enterotoxin-producing bacteria. Using the Chinese hamster ovary cell assay, 40 of 213 isolates (18.8%) produced heat-labile (LT) enterotoxin. These LT-producing isolates comprised 33 of 177 (18.6%) strains from 24 of 68 food samples (35.3%) and 7 of 36 (19.4%) strains of 4 of 17 water samples (23.5%). One LT-producing strain each of *Salmonella emek* and of *Shigella dysenteriae* was found. 2 strains of LT-enterotoxigenic *Escherichia coli* O68 were found in water. No enterotoxigenic *E. coli* were isolated from food, but 13 of the LT-producing strains were *Enterobacter, Klebsiella, Serratia* and *Proteus* spp., and 7 food samples yielded >1 sp. of enterotoxigenic bacterium. Of the enterotoxigenic isolates from food, 15 were oxidase-positive strains of *Aeromonas, Pseudomonas, Achromobacter, Flavobacterium* and *Vibrio*. LT-enterotoxigenic *Enterobacter, Acinetobacter, Klebsiella, Proteus, Providencia* and *Serratia* spp. represented 20 of the food and water isolates. The survey demonstrated the presence in food and water of enterotoxigenic bacteria

of the same spp. as those isolated from cases of infantile diarrhoea in the same community, although a correlation between these sources and infantile diarrhoea remains to be established. AL

52

[Food poisoning in communal catering. Account of 4 years of control.]

Guerin, M. S.; Luguet, F. M.; Goussault, B.; Billaux, F.
Alimentation et la Vie 68 (1) 22–29 (1980) [30 ref. Fr] [Inst. Sci. d'Hygiene Alimentaire, Rue de Chemin Blanc, BP 138, 91160 Longjumeau, France]

Results from 4 yr investigations into outbreaks of food poisoning in various catering establishments (restaurants, schools, hospitals) in the Paris region are reported. They included questionnaires to consumers, to kitchen staff, and bacteriological control data. Tabulated data showed that food poisoning was caused by meat products (14 cases), poultry (1 case) and pastry (1 case). The organisms responsible were staphylococci (3), *Clostridium perfringens* (13, all in meat and poultry products), and 3 unidentified. RM

53

[Effect of glucono-δ-lactone on growth of enterotoxigenic staphylococci.]

Rajkovic, N.; Tadic, D.
Tehnologija Mesa 21 (3) 79–80 (1980) [7 ref. Sh, en] [Katedra za Higijenu Mesa, Vet. Fak., Belgrade, Yugoslavia]

Effects of 0.8, 0.9 or 1.0% glucono-δ-lactone (GDL) on growth of enterotoxigenic *Staphylococcus aureus* strain 5–6 cultured in 'Torlek' liquor medium at 37°C for 18 h, were investigated. The results show that 1% GDL gives complete inhibition, whereas the *Staph. aureus* count is unaffected by the 2 lower concn. STI

54

[Disinfective activity of Sterinol against *Staphylococcus aureus*.]

Maleszewski, J.; Wittlin, E.; Tarkowski, J. A.
Medycyna Weterynaryjna 35 (11) 645–647 (1979) [10 ref. Pl, ru, en] [Samodzielna Pracownia Mikrobiol. & Biochem. Produktow Zwierzecych Inst. Weterynarii w Pulawach, Warsaw, Poland]

Sterinol, a 10% aqueous solution of a benzalkonium bromide cationic surfactant, was tested against dispersions in saline or nutrient broth of the enterotoxic strain of *Staph. aureus* 262 dried on glass slides. Concn. of 0.2–1.0% were used at 40°C and at room temp., application being for 1–9 min. It was found that Sterinol was fully effective at 1% for ≥5 min; and it is concluded that Polish regulations on cleaning and disinfection in meat factories involving application of Sterinol at 1% for 15 min should ensure complete disinfection. SKK

55

Staphylococcal food poisoning by consumption of sterilized vanilla custard.

Beckers, H. J.; Coutinho, R. A.; Jansen, J. T.; Leeuwen, W. J. van
Antonie van Leeuwenhoek 46 (2) 224–225 (1980) [En] [Lab. for Zoonoses & Food Microbiol., Nat. Inst. of Public Health, PO Box 1, 3270 BA Bilthoven, Netherlands]

In July 1978, 26 people suffered gastric disorders (lasting 4–72 h) after eating UHT custard. *Staphylococcus aureus* strains with an unusual phage pattern, producing enterotoxin A, were isolated from the custard, from patients' faeces, and from the nose of an employee working in the department where the custard was aseptically packaged under pressure by filtered air. It was concluded that some packages were contaminated after UHT treatment, either by this employee or by leakage of an air filter. ADL

56

[Food poisoning caused by bacteria.]

Burzynska, H.
Zywieni Czlowieka 6 (3) 151–157 (1979) [27 ref. Pl]

A brief review is given covering the main pathogenic and toxigenic bacteria occurring in foods (*Clostridium* spp., *Bacillus cereus, Escherichia coli, Shigella* sp., *Vibrio parahaemolyticus, Klebsiella pneumoniae, Yersinia enterocolitica, Pseudomonas aeruginosa, Salmonella* spp.); factors influencing microbial contamination of foods (raw material quality, mechanization, factory hygiene, poor storage conditions, inefficient sterilization, etc.); and hygiene requirements and measures for minimization of microbial contamination. IN

57

[Natural toxins occurring in foods of vegetable or animal origin.]

Rusiecki, W.
Zywieni Czlowieka 6 (3) 131–141 (1979) [Pl]

An introductory review of the main phytotoxins and their occurrence is presented. Food poisoning is discussed in detail; possible causes include poisonous or conditionally edible mushrooms, certain Leguminosae toxins, cereal parasites and weeds, alkaloids, microbial toxins, and toxins present in sea food. Data are included on the type of illness, early symptoms and long term effects. IN

58

Capture of latex beads, bacteria, endotoxin, and viruses by charge-modified filters.

Hou, K.; Gerba, C. P.; Goyal, S. M.; Zerda, K. S.
Applied and Environmental Microbiology 40 (5) 892–896 (1980) [12 ref. En] [AMF/CUNO, Meriden, Connecticut 06450, USA]

This report demonstrates how electropositive filters can be used to enhance the removal of microorganisms and other negatively charged particles from water. It was shown that electropositive depth filters were capable of adsorbing viruses and endotoxins many times smaller than the average pore size of the filter.

Electronegative filters of similar porosity or electropositive filters that had been treated to destroy the positive charge were almost ineffective under similar conditions for the removal of viruses and small latex spheres. The results of this study indicate that electropositive filters are highly effective in the removal of a wide range of contaminants over a wide range of pH values and ionic conditions. AS

59

[Serotypes of *Bacillus cereus* isolates from cooked and raw rice responsible for food poisoning and from healthy people.]

Shinagawa, K.; Kunita, N.; Onaka, T.; Takemasa, N.
Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 21 (4) 266–272 (1980) [10 ref. Ja, en] [Osaka Prefectural Inst. of Public Health, Nakamichi 1-chome, Higashinari-ku, Osaka, Japan]

Anti *B. cereus* H sera of 19 serotypes were prepared with 18 strains of *B. cereus* and an additional SH-1 strain isolated from an outbreak of *B. cereus* food poisoning. The titers of Anti H sera ranged from 3200 to 12 800. Some of these sera cross-agglutinated with heterologous antigens, but mono-specific H sera were prepared by absorption. In 11 of 13 "vomiting type" outbreaks incriminated foodstuffs or clinical specimens or both yielded H-serotype 1 only. The other 2 outbreaks yielded serotypes 3 and SH-1. Two "diarreal type" outbreaks yielded serotype 8 only. Of 140 isolates, 98 (70.0%) were serotype 1, 20 were serotype 8, 11 were serotype SH-1, 6 were serotyppe 3, and 5 (3.6%) were not typable (NT). In all, 135 of the 140 (96.4%) strains isolated from these episodes were typable. Of 10 food poisoning outbreaks involving not only *B. cereus* but also *Staphylococcus aureus*, one yielded serotype 1 and one yielded serotype 3, while the other 8 each yielded 2 or 3 serotypes, 1 + SH-1, 1 + NT, 1 + SH-1 + NT, or NT alone. Of 70 isolates, 21 (30.0%) were serotype 1, 8 were serotype 3, 4 were serotype SH-1 and the other 37 (52.9%) were NT. Of 115 isolates from cooked rice, 29 (25.2%) were serotype 1, 10 were serotype 8, 8 were SH-1, 6 were serotype 12, and 44 (38.3%) were NT; the others were serotype 3, 5, 9, 14, 16, or 18. Of 55 isolates from raw rice, 7 (12.7%) were serotype 7, 4 were serotype SH-1, 2 were serotype 1, one was serotype 8 and the other 41 (74.5%) were NT. *B. cereus* was isolated from 65 of 433 (15.0%) samples of faeces of healthy food handlers and school children; of these 65 isolates, 10 (15.4%) were serotype 1, 44 (67.7%) were NT, and the others were serotype SH-1, 8, 5, 12, or 14. AS

60

[Experimental study on the survival of enterotoxin type A in canned food.]

Bugrova, V. I.; Prizrenova, I. I.
Voprosy Pitaniya No. 3, 61–62 (1980) [4 ref. Ru, en] [Inst. Pitaniya AMN SSSR, Moscow, USSR]

Canned 'sprats in oil' were inoculated with *Staphylococcus aureus* No. 3278 (which forms type A enterotoxin), and incubated at 37°C for 48 h to allow enterotoxin formation. Enterotoxin was determined in test samples before and after sterilization at 120°C for 20, 25 or 30 min and in controls (without sterilization) by gel diffusion with an anti-enterotoxin serum type A. In controls the enterotoxin was localized at the sites of contamination and reproduction of the *Staph. aureus*. No enterotoxin was detected in test samples. It was concluded that the sterilization at 120°C for 25–30 min, as currently performed in manufacture of canned 'sprats in oil', ensures total inactivation of the heat-resistant enterotoxin from staphylococci. RAW

61

[Isolation of *Clostridium botulinum* B strains from blown cans of meat.]

Skoczek, A.; Mierzejewski, J.
Medycyna Weterynaryjna 35 (12) 736–738 (1979) [19 ref. Pl, ru, en] [Osrodek Naukowo-Badawczy Sluzby Weterynaryjnej, Pulawy, Poland]

1023 cans of various meat products which had become blown after storage were examined. Isolation and identification of clostridia were carried out by generally accepted procedures. The results are fully described. 430 strains of anaerobic sporeformers were isolated, of which 366 had morphological, cultural and biochemical characteristics corresponding to those of the *C. sporogenes/C. botulinum* group. 9 of these strains were found to produce botulinus neurotoxin. Endospores of 4 of the strains showed higher heat resistance than the control *C. botulinum* strain no. 1162, 420–600 min at 100°C vs. 120 min at 100°C being required for kill. SKK

62

Modelling microbial populations during meat cooking and cooling.

Thompson, D. R.; Busta, F. F.
ASAE Paper No. 79-6520, 34pp. (1979) [16 ref. En] [Dep. of Agric. Eng., Univ. of Minnesota, St. Paul, Minnesota, USA]

The mathematical model of Thompson et. al [FSTA (1979) 11 8S1265] was further developed and applied to growth of *Clostridium perfringens* in cooked meat. Growth and inactivation mechanisms predicted by the model are discussed and evaluated, including induction, the transient phase, the exponential growth phase, environmental lag, decline in growth rate with increasing temp., cell concentration effects on growth, and inactivation. A simplified method for prediction of bacterial counts was developed from the above model by means of dimensional analysis; its use is discussed. Predicted and experimental data for growth, inactivation and regrowth of *Cl. perfringens* in meat during long-time-low-temp. cooking and cooling were compared; agreement was generally good. This helps to substantiate the mechanisms assumed in the model. Predictive accuracy of the simplified model is less than for the full model, but appears to be adequate for routine use. AJDW

63

[Antibiotic properties against *Clostridium botulinum B of Clostridium sporogenes* strains isolated from canned meat.]
Mierzejewski, J.
Medycyna Weterynaryjna 35 (4) 220–222 (1979) [9 ref. Pl, ru, en] [ul. Krancowa 1/15, 24-100 Pulawy, Poland]

249 strains of *C. sporogenes* isolated from 500 blown meat cans that had been kept 1–4 yr without refrigeration (including 178 isolated from 287 cans of ground pork) were examined. 56 (22%) of the strains were found to produce bacteriocines against *C. botulinum* B 1162. Cultures of the 4 most active strains reached max. activity after incubation for 2–3 days. The strains exhibited antibiotic activity also against *C. perfringens* A and a museum strain of *C. sporogenes*, but to a lesser extent than against *C. botulinum*. SKK

64

Food poisoning organisms in frozen foods – effect of freezing and cold storage.
Hall, L. P.; Slade, P. J.
Technical Memorandum, Campden Food Preservation Research Association No. 222, 22pp. (1979) [50 ref. En]

A literature survey was made covering work on the behaviour of stressed cultures of *Salmonella* sp. and *Staphylococcus aureus*, methods of detecting staphylococcal enterotoxin, and the prevalence of various *Salmonella* serotypes and types of enterotoxin in outbreaks of food poisoning. Pork, beef, chicken and prawns were chosen as substrates for *S. hadar* and *S. typhimurium* (chicken), *S. bredeney* and *S. typhimurium* (beef), *S. agona* and *S. typhimurium* (pork), *S. typhimurium* only (prawns). A single strain of *Staph. aureus* which produces high yields of enterotoxin A was used for inoculation into all substrates. All strains were tested for display of typical culture characteristics using selective media and diagnostic tests. Methods of enterotoxin detection were investigated and the most suitable one was developed. Preliminary growth rate studies were used to predict the vol. of inoculum required for each substrate. Each *Salmonella* serotype was inoculated in pure culture into samples of sterilized substrates, counts and diagnostic tests being performed before and immediately after freezing and after 1, 3, 7 and 14 days' storage at −24°C. Results of these tests have yet to be collated and analysed. AS

65

Microbial toxins.
Mulky, M. J.
Indian Food Packer 32 (5) 4–13 (1978) [10 ref. En] [Hindustan Lever Res. Cent., Andheri, Bombay, India]

Aspects discussed include: exotoxins; toxoids; vaccines/toxoids; sera; uses of exotoxins; biological assay of toxin/antitoxin; endotoxins; Schwartzman phenomenon; Sanarelli effect; staphylococcis; salmonella food poisoning; botulism; *Clostridium perfringens* syn. *welchii; Bacillus cereus; Shigella; Vibrio parahaemolyticus; V. cholerae;* fungal toxins; *Aspergillus* spp.; *Penicillium* spp.; diagnosis of mycotoxicoses in animals; and prevention and control of mycotoxicosis. CFTRI

66

[Possibility of growth of *Clostridium botulinum* in tomato juice.]
Gola, S.; Casolari, A.
Industria Conserve 55 (4) 294–298 (1980) [27 ref. It, en] [Sta. Sperimentale per l'Ind. delle Conserve Alimentari, Parma, Italy]

The possibility of growth of *Cl. botulinum* spores together with some microorganisms in tomato juice, pH 4–4.3 was investigated, using 3 strains of *Cl. botulinum*, 6 moulds, 6 enterobacteria, 2 bacilli and 1 *Pseudomonas*. The spores were found to grow and form toxins in the presence of 2 enterobacteria (*Serratia marcescens* and *Enterobacter aerogenes*) and 1 strain of *Aspergillus* (A.AL). In the presence of other bacteria (*Proteus* sp., *Citrobacter* sp., *Klebsiella* sp., *Escherichia coli, Pseudomonas* sp., *Bacillus licheniformis* and *B. polymixa)* and 5 other mould strains the spores did not grow. *Cl. botulinum* growth was correlated with the rise in pH brought about by the bacteria and apparently with the O_2 tension in the environment. The other 5 moulds appeared to inhibit growth of *Cl. botulinum* in spite of the rise in pH, presumably by the production of antibiotic metabolites. [From En summ.] RM

67

[Bacterial contamination of dairy products from Piura. II. Smooth (butter) cheese.]
Diaz V., M. C.; Galecio R., J.; Gutierrez-Correa, M.
Anales Cientificos 15 (1/4) 39–41 (1977) [17 ref. Es, en] [Dep. de Ciencias Biol., Univ. Nacional de Piura, Peru]

24 samples of butter cheese were obtained at fortnightly intervals during June–July 1974 from the central market in Piura. All had high counts of Enterobacteriaceae (20.58% of which were salmonellae) and streptococci. Counts of *Staphylococcus aureus* were low, but 23 of the 47 strains of this species isolated were coagulase-positive, suggesting that numerous cases of food poisoning occurring among cheese consumers in Piura during 1973 and 1974 may have been due to *S. aureus* enterotoxins. None of the samples tested complied with Section 137 of the Peruvian Food Hygiene Code, which requires cheeses to be free of pathogenic bacteria. ADL

68

[Some factors influencing multiplication and survival of *Staphylococcus aureus* in cheese and formation of staphylococcal enterotoxin.] [Review]
Petrushina, L. I.
Voprosy Pitaniya No. 3, 11–16 (1980) [92 ref. Ru] [Inst. Pitaniya AMN SSSR, Moscow, USSR]

69

Inhibition of *Staphylococcus aureus* growth and enterotoxin-A production in Cheddar cheese produced with variable starter activity.
Ibrahim, G. F.; Baldock, A. K.; Radford, D. R.; Ireland, L. B.
Journal of Food Protection 44 (4) 263–267 (1981) [10 ref. En] Dep. of Agric., Dairy Res. Cent., PO Box 217, Richmond, NSW, Australia]

Twelve cheese batches were made with variable starter activity, from milk inoculated with *Staphylococcus aureus*. At the end of cheddaring, only half the curd of each batch was salted and each portion was then pressed separately, cut and stored at 11° and 4°C for 6 weeks. Changes in bacterial counts, pH, enterotoxin A concn. and organoleptic properties were monitored. At the end of cheddaring, enterotoxin was detected in batches made with large initial inocula of *S. aureus* and/or low starter activities. At the end of pressing, the count of *S. aureus*, pH and enterotoxin concn. in the unsalted cheese (USC) were significantly lower than in salted cheese (SC), due to the adverse effect of salting on growth of microorganisms other than *S. aureus*. No change in enterotoxin concn. was detected in USC during storage at 11° and 4°C, and a sharp decline in *S. aureus* count occurred. The rate of such decline at 11°C exceeded that at 4°C. Increases in *S. aureus* count and enterotoxin concn. occurred in some SC batches stored at 11°C, whereas a slight decrease in *S. aureus* count and no change in enterotoxin concn. occurred in all SC stored at 4°C. At the end of storage, no cheeses had gas defects or significant flavour defects, which could have prohibited further processing. AS

70

Distribution of *Clostridium botulinum* around fishing areas of the western part of Indonesian waters.

Suhadi, F.; Thayib, S. S.; Sumarsono, N.

Applied and Environmental Microbiology **41 (6)** 1468–1471 (1981) [16 ref. En] [Lab. of Biol., Nat. Atomic Energy Agency, Jakarta-Selatan, Indonesia]

A survey was carried out to determine the presence of *Cl. botulinum* in samples of sediment and seafoods (fish, shellfish, shrimp, crab) collected from 109 sites around the coastal fishing areas of N. Java, E. Sumatra and W. and E. Kalimantan. Among the 3433 samples, 82 (2.4%) were positive for *Cl. botulinum*; of the 2577 raw seafoods and 264 boiled fish samples, 70 (2.7%) and 1 (0.4%) resp. were positive. Type E was not found. AL

COPYRIGHT REGULATIONS

Form of Declaration and Undertaking

To the Editor, International Food Information Service, Lane End House, Shinfield, Reading, RG2 9BB, Berkshire, England.

1. I.....

   of.....

   Hereby request you to make and supply to me a photocopy of the article covered by Abstract No. .....

   Journal name.....

   Volume ..... Part ..... Pages ..... Year .....

   which I require for the purposes of research or private study.

2. I have not previously been supplied with a copy of the said article/part of the said work by any librarian.

3. I undertake that if a copy is supplied to me in compliance with the request made above, I will not use it except for the purposes of research or private study.

   Signature ..... Date .....

   (Note: This must be the personal signature of the person making the request. A stamped or typewritten signature or the signature of an agent is NOT sufficient.)

4. Send this form and remittance (20p per page for photocopies, min. charge £2.00 per article) to the above address. A deposit or credit system for payment is also in operation. Details are available on request.

Note: Additional forms are available on-request.

Food Annotated Bibliographies (FABs)

	1969-80 Price	1981 Price	1982 12 monthly issues Price
1. Application of Reverse Osmosis to Food Processing	□ £10.00	□ £5.50	□ £9.00
2. New Sources of Food Protein	□ £18.00	□ £12.00	□ £19.00
3. Natural and Synthetic Sweeteners	□ £11.00	□ £6.50	□ £10.50
4. Techniques for Analysis of Flavour Volatiles	□ £12.00	□ £7.50	□ £12.00
5. Microwaves in Food Processing	□ £9.50	□ £5.00	□ £9.00
6. Texture Analysis of Foods	□ £15.00	□ £8.00	□ £13.00
7. Synthetic Dairy Products	□ £10.00	□ £5.50	□ £9.50
8. Acidulants in Food	□ £10.00	□ £5.50	□ £9.00
9. Agglomeration of Powders	□ £10.00	□ £5.50	□ £9.00
10. Aseptic Packaging	□ £10.00	□ £6.50	□ £10.00
11. EEC Regulations	□ £10.00	□ £5.50	□ £9.00
12. Toxicology of Food Additives	□ £11.00	□ £6.50	□ £10.50
13. Deep Fat Frying	□ £13.00	□ £7.50	□ £12.00
14. Viscosity of Foods	□ £11.00	□ £6.00	□ £9.50
15. Taste Panels in Food Science	□ £12.00	□ £7.50	□ £12.00
16. Taints in Food	□ £10.00	□ £6.00	□ £10.00
17. Microbial Toxins in Food	□ £12.00	□ £7.50	□ £12.00
18. Smoked Food Products	□ £10.00	□ £5.50	□ £9.00
19. Disposal of Waste Food Products	□ £14.50	□ £8.00	□ £13.00
20. Use of Glucose in Food Products	□ £9.50	□ £5.00	□ £9.00
21. Emulsifiers in Foods	□ £11.00	□ £6.50	□ £10.50
22. Stabilizers in Foods	□ £11.00	□ £6.50	□ £10.50
23. Staling and Antistaling Additives	□ £9.50	□ £5.00	□ £9.00
24. Catering Industry	□ £9.50	□ £6.00	□ £9.50
25. Antioxidants	□ £11.00	□ £6.50	□ £10.50
26. Nitrosamines	□ £9.50	□ £5.00	□ £9.00
27. Content and Analysis of Mercury in Foods	□ £10.00	□ £6.50	□ £10.50
28. Content and Analysis of Lead in Foods	□ £10.00	□ £5.50	□ £9.00
29. Heatable Packs	□ £9.50	□ £5.00	□ £8.50
30. Sulphur Dioxide in Food Products	□ £10.00	□ £5.50	□ £9.00
31. Lactic Acid Bacteria in Beverages and Food	□ £12.00	□ £7.50	□ £12.00
32. Colorants	□ £10.00	□ £5.50	□ £9.00
33. Browning of Foods	□ £10.00	□ £5.50	□ £9.00
34. Aflatoxins	□ £10.00	□ £6.50	□ £10.50
35. Antibiotic Properties and Residues in Food excluding Nisin	□ £9.00	□ £5.00	□ £8.50
36. Nisin	□ £9.00	□ £5.00	□ £8.50
37. Cadmium in Foods	□ £9.50	□ £5.50	□ £9.00
38. Coffee	□ £10.00	□ £6.00	□ £10.00
39. Sorbic Acid	□ £10.00	□ £5.50	□ £9.00
40. Arsenic in Foods	□ £9.00	□ £5.50	□ £9.00
41. Ascorbic Acid	□ £9.00	□ £6.00	□ £10.00
42. Thickeners and Gelling Agents	□ £8.50	□ £5.50	□ £9.00
43. Pseudomonadaceae and Food Processing	□ £9.00	□ £5.00	□ £8.50
44. Spores in Food	□ £8.00	□ £6.00	□ £9.50
45. Breadmaking	□ £10.00	□ £5.50	□ £9.00
46. Bread Properties	□ £9.00	□ £5.00	□ £8.50
47. Food Science and Technology Books	□ £15.00	□ £9.50	□ £17.00
48. Nitrates and Nitrates in Meat Products	* □ £10.00	□ £6.00	□ £10.00
49. Eggs and Poultry Meat	□ £15.00	□ £8.50	□ £13.50
50. Mycotoxins in Foods (Excluding Aflatoxins and Microbial Toxins)	* □ £8.00	□ £5.50	□ £9.00
51. Meat Canning	* □ £10.00	□ £5.50	□ £10.00

* Only available from 1974.

Prices include postage by surface mail. For airmail rates, please apply to address below.

To order, or obtain further information, mark the item required, add your name and address and send cash, cheque or postal order to :

INTERNATIONAL FOOD INFORMATION SERVICE (IFIS),
LANE END HOUSE,
SHINFIELD, READING. RG2 9BB.
ENGLAND.

Name .....

Address .....

.....